

MIDDLE JURASSIC OSTRACODA  
FROM SOUTH YORKSHIRE



BY  
RAYMOND HOLMES BATE, Ph.D.

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By R. H. BATE

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## SYNOPSIS

The Bajocian ostracods from the Hydraulic Limestone and associated marine sediments of South Yorkshire are described. Twenty-one genera and twenty-seven species are recorded, of which four genera and twelve species are new. Eight families within the single order Podocopida Müller 1894 are recognized. The Hydraulic Limestone/ Eller Beck Bed horizon is correlated with the Kirton Cementstone Series of Lincolnshire and is considered to be of *discites* age.

### I. INTRODUCTION AND ACKNOWLEDGEMENTS

THE present paper, dealing with the marine ostracods of the Hydraulic Limestone and associated marine sediments of South Yorkshire is the second of four papers dealing with the Middle Jurassic ostracod faunas of north-eastern England.

The localities from which the samples were obtained occur both to the north and to the south of the town of Market Weighton, the latter having given its name to the stable area (in Middle Jurassic times) on which it is situated. To the north of this stable area the Middle Jurassic sediments are deltaic with occasional marine incursions, the Hydraulic Limestone representing the first such marine incursion of the Yorkshire delta, table 1.



TABLE I

Generalized table of strata occurring to the north and south of Market Weighton.

<i>Strata north of Market Weighton</i>	<i>Strata south of Market Weighton</i>	<i>Stages</i>
CORNBRASH (UPPER)	UPPER	CALLOVIAN
UPPER DELTAIC SERIES	" ESTUARINE "	BATHONIAN
GREY LIMESTONE SERIES	SERIES	
MIDDLE DELTAIC SERIES (UPPER)		
MILLEPORE SERIES	CAVE OOLITE	BAJOCIAN
MIDDLE DELTAIC SERIES (LOWER)	BASEMENT BEDS	
ELLER BECK BED/ HYDRAULIC LIMESTONE	HYDRAULIC LIMESTONE	
LOWER DELTAIC SERIES	LOWER " ESTUARINE "	
DOGGER	SERIES	
LIAS	LIAS	TOARCIAN

To the south of the Market Weighton "structure" the sequence is poorly exposed, the beds associated with the Hydraulic Limestone being separated from the Upper Lias by a thin sequence of Lower "Estuarine" Series. The most fossiliferous section occurs at South Cave, Eastfield Quarry (map reference SE/913323), where the ferruginous marls and rubbly limestones (Basement Beds of Neale 1958), which overlie the Hydraulic Limestone, were excavated in a working to test the thickness of the overlying Cave Oolite. This section is no longer exposed. It was, however, measured and sampled by Professor P. C. Sylvester-Bradley in 1947. Samples of marl brought up out of the working as well as the samples collected by Sylvester-Bradley were examined. The Hydraulic Limestone was sampled by the Ellerker Beck (map reference SE/927297) where it originally outcropped but is now represented only as large boulders at the surface. North of Market Weighton the most important section occurs on the Firby road near Kirkham Priory (map reference SE/738658). Here the Hydraulic Limestone is somewhat impersistent and underlain by 8 ft. of grey shale and ferruginous sandstone. Further north there are no exposures except for a disused working near Castle Howard station (map reference SE/735666). Elsewhere the course of the limestone is marked by the presence of fragments of the rock at the surface, of which a sample was collected near Ganthorpe (map reference SE/704698). Material collected from the Kirton Cementstone Series, Greetwell Quarry, Lincoln (map reference TF/002725), and not included in Bate 1963, is described in the present paper.

The change northwards of the Hydraulic Limestone, and of the marine beds associated with it, into a thick bed of ripple marked sandstone (maximum thickness 22 ft. 7 in.) with fossiliferous ironstone bands indicates the nearness of the delta front in the northern part of the Yorkshire basin. Unfortunately the lithology of the sandstone (Eller Beck Bed) is such that if any ostracods were originally present, they have long since been leached away. No ostracods have been found in the ironstone bands. Correlation of this bed with the Hydraulic Limestone is, therefore, purely stratigraphic.

The Hydraulic Limestone (maximum thickness 4 ft.) and associated marine sediments probably never total more than 18 ft. and are often considerably less. Absence of complete exposures makes an estimate of the total thickness difficult. The Hydraulic Limestone/Eller Beck Bed represents a marine transgression from the south and is to be correlated with the Lincolnshire Limestone. The similarity of the ostracod fauna (in the absence of any ammonite evidence in Yorkshire) suggests that this horizon can be fairly accurately correlated with the Kirton Cementstone Series and thus would be of *discites* age.

The work embodied in this paper was commenced in the Geology Department of the University of Sheffield. I would like to record my sincere thanks to Professor L. R. Moore for the use of the facilities of that Department. I am also deeply indebted to Professor P. C. Sylvester-Bradley for guidance throughout the research and also for the use of the departmental facilities whilst at Leicester University. The award of a D.S.I.R. research studentship grant is also gratefully acknowledged.

All registered specimens mentioned in the text are now in the Department of Palaeontology, British Museum (Natural History).

## II. SYSTEMATIC DESCRIPTIONS

Subclass OSTRACODA Latreille 1806

Order PODOCOPIDA Müller 1894

Suborder PLATYCOPINA Sars 1866

Family CYTHERELLIDAE Sars 1866

Genus *CYTHERELLOIDEA* Alexander 1929

TYPE SPECIES. *Cytherella williamsoniana* Jones.

*Cytherelloidea eastfieldensis* sp. nov.  
(Pl. I, figs. 1-5, Text-fig. 1)

DIAGNOSIS. A *Cytherelloidea* with carapace elongate, incurved middorsally and midventrally. A prominent ridge extends around the valve periphery, bending into the centre middorsally to produce a question mark-shaped ridge. Shell surface weakly reticulate.

HOLOTYPE. Io. 900, Basement Beds (marl facies), Eastfield Quarry, South Cave.

PARATYPES. Io. 901-05, horizon and locality as above.

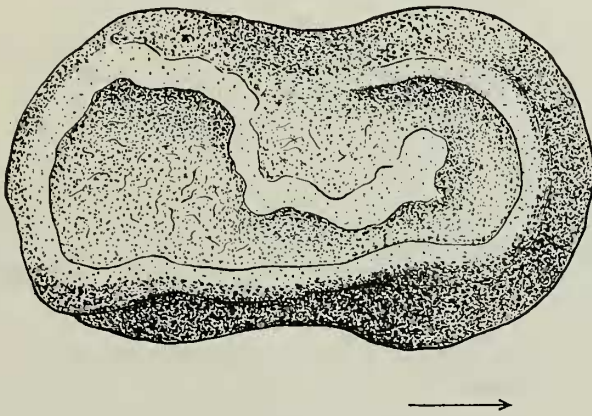


FIG. 1. Camera lucida drawing, right valve, *Cytherelloidea eastfieldensis* sp. nov., paratype Io. 901,  $\times 110$  approx.

DESCRIPTION. *Carapace* subrectangular in lateral view. Dorsal and ventral margins strongly incurved medially. A prominent ridge extends around the valves, continuous except in the middorsal region where the ridge bends down into the centre of the valve to curve forwards, producing a large, question mark-shaped ridge. Depending upon the individual specimens, this ornament may be either complete or only partially developed, in which case the central ridge is separate from the peripheral ridge. Shell surface may be weakly reticulate, but dependent upon

the state of preservation. *Right valve* larger than the left which it overlaps strongly on all sides. Greatest length passes through midpoint; greatest height in the anterior or posterior third. Greatest width in the posterior third. Internally, the *muscle scars*, typical of the genus, are situated on a node just dorsal of midpoint. A shallow groove extends around the valve margin in the right valve for the reception of the left.

#### *Dimensions*

Holotype. Io. 900 carapace (Pl. 1, figs. 2-5) length 0.63 mm.; height 0.36 mm.; width 0.16 mm.

Paratypes. Io. 901 R.V. (Pl. 1, fig. 1, Text-fig. 1) length 0.68 mm.; height 0.40 mm. Io. 902 L.V. length 0.59 mm.; height 0.44 mm.

REMARKS. This species resembles *Cytherelloidea paraweberi* (Oertli 1957, pl. 1, figs. 12-15) except for the fact that the peripheral ridge in the latter is continuous around the carapace and not discontinuous middorsally as in the former.

*C. eastfieldensis* is not restricted to the type locality, being found throughout the Kirton Cementstone Series, Greetwell Quarry, Lincoln, where it is, however, only poorly preserved. This is not a common species.

Suborder PODOCOPINA Sars 1866  
Superfamily CYPRIDACEA Baird 1845  
Family PARACYPRIDIDAE Sars 1923  
Genus **PARACYPRIS** Sars 1866

TYPE SPECIES. *Paracypris polita* Sars.

#### *Paracypris bajociana* Bate

1963 *Paracypris bajociana* Bate : 186, pl. 2, figs. 1-8.

REMARKS. Most common in the marl underlying the Cave Oolite (Basement Beds), South Cave, from which horizon three paratypes were selected in the original description. The species also occurs in the Hydraulic Limestone of Ellerker and in the underlying marine sediments exposed on the Firby road.

Superfamily CYTHERACEA Baird 1850  
Family BYTHOCYTHERIDAE Sars 1926  
Genus **MONOCERATINA** Roth 1928

TYPE SPECIES. *Monoceratina ventrale* Roth.

#### *Monoceratina vulsa* (Jones & Sherborn) (Pl. 1, fig. 6)

1888 *Cytheridea vulsa* Jones & Sherborn : 263, pl. 2, fig. 4a-b.

1938 *Monoceratina vulsa* (Jones & Sherborn) Triebel & Bartenstein : 516, pl. 3, figs. 17, 18.

?1955 *Bythocythere aliena* Ljubimova : 34, pl. 2, fig. 3a-b.

1960 *Monoceratina* cf. *vulsa* (Jones & Sherborn) ; Lutze : 433, pl. 37, fig. 5a-b.

1963 *Monoceratina vulsa* (Jones & Sherborn) ; Bate : 189, pl. 3, figs. 5-12.

REMARKS. This is not a common ostracod in the sediments associated with the Hydraulic Limestone and only a few isolated valves have been found in the Basement Beds (marl facies), South Cave.

Family PROGONOCYTHERIDAE Sylvester-Bradley 1948

Subfamily PROGONOCYTHERINAE Sylvester-Bradley 1948

Genus **PROGONOCYTHERE** Sylvester-Bradley 1948 emend Bate 1963

TYPE SPECIES. *Progonocythere stilla* Sylvester-Bradley.

***Progonocythere cristata*** Bate

1963 *Progonocythere cristata* Bate : 191, pl. 4, figs. 5-15, pl. 5, figs. 1-6.

REMARKS. Several poorly preserved specimens of this species have been found in the Hydraulic Limestone of Ellerker and in the Firby road section. At the equivalent horizon in Lincolnshire (Kirton Cementstone Series) the ostracod is also uncommon. The species becomes increasingly numerous at higher horizons, being well represented within the Kirton Shale at the type locality (Kirton Lindsey).

***Progonocythere reticulata*** sp. nov.

(Pl. 1, figs. 7-13, Pl. 2, figs. 1-11)

DERIVATION OF NAME. Latin, *reticulatus*, net-like.

DIAGNOSIS. A *Progonocythere* with carapace strongly reticulate.

HOLOTYPE. Io. 909, Basement Beds (marl facies), Eastfield Quarry, South Cave.

PARATYPES. Io. 910-18, horizon and locality as above.

DESCRIPTION. *Carapace* subquadrate in the female dimorph, elongate in the male. Greatest length in both dimorphs extends through midpoint; greatest height in the anterior third; greatest width just behind midpoint. Ventrolateral margin of carapace convex, projected below the ventral surface, most strongly so in the male. In both sexes the greatest development of this ventrolateral extension is median, contrasting with the backwardly directed extension of the type species. *Shell surface* strongly reticulate, the ornamentation consisting of 4-5 sided pits. The size of the pits increases towards the centre of the carapace, those around the periphery being small and commonly circular in shape. Ventral surface of carapace with 4-5 weakly developed, longitudinal and parallel ridges on each valve. *Normal pore canals* well developed in the peripheral part of the valve, large and widely scattered. *Left valve* larger than the right, which it overreaches on all sides except at the extreme anterior. Along the ventral margin the left valve overlaps the right. Dorsal margin straight, sloping towards the posterior. Anterior cardinal angle broadly convex, posterior cardinal angle sharply angled. Posterior narrowly rounded, somewhat truncated, with a convex posteroventral slope and a concave posterodorsal slope. Anterior rounded, marginally compressed. Ventral margin convex, medially incurved. *Right valve*: dorsal margin slightly convex in the female, straight in the male, in both cases sloping to the posterior. Cardinal angles



distinct. Anterior rounded, marginally compressed, anterodorsal slope concave. Posterior triangular, posterodorsal slope strongly concave, posteroventral slope convex. Ventral margin convex, medially incurved. *Hinge* entomodont with a broad shelf-like accommodation groove in the left valve. Right valve with approximately 8 anterior teeth and 6–7 posterior teeth, the anterior element being continuous below the median groove. *Selva*ge most strongly developed midventrally. *Inner margin* and *line of conrescence* coincide. *Radial pore canals* short and straight, widely spaced, approximately 8 anteriorly and 4 posteriorly. *Muscle scars* consist of a subvertical row of 4 oval adductor scars, an anterodorsal, oval antennal scar and a rounded anteroventral mandibular scar (Type A, Bate 1963).

#### *Dimensions*

Holotype. Io. 909 female carapace (Pl. 1, figs. 7, 9, 13) length 0.59 mm.; height 0.40 mm.; width 0.36 mm.

Paratypes. Io. 910 female L.V. (Pl. 1, figs. 8, 10, Pl. 2, fig. 11) length 0.55 mm.; height 0.40 mm. Io. 911 female R.V. (Pl. 2, fig. 7) length 0.60 mm.; height 0.39 mm. Io. 912 male carapace (Pl. 2, figs. 1, 3, 4) length 0.67 mm.; height 0.44 mm.; width 0.37 mm. Io. 913 male L.V. (Pl. 2, figs. 2, 8) length 0.65 mm.; height 0.41 mm. Io. 914 male R.V. (Pl. 2, fig. 6) length 0.64 mm.; height 0.39 mm. Io. 915 female R.V. (Pl. 1, fig. 11, Pl. 2, fig. 10) length 0.56 mm.; height 0.35 mm. Io. 916 female L.V. (Pl. 1, fig. 12) length 0.52 mm.; height 0.37 mm. Io. 917 male R.V. (Pl. 2, fig. 9) length 0.65 mm.; height 0.37 mm. Io. 918 male L.V. (Pl. 2, fig. 5) length 0.67 mm.; height 0.41 mm.

REMARKS. Apart from the occurrence of this species at the type locality, where it is a common ostracod, it has, so far, only been found elsewhere in the Hydraulic Limestone near Castle Howard station.

### Genus *ACANTHOCY THERE* Sylvester-Bradley 1956 emend Bate 1963

TYPE SPECIES. *Cythere sphaerulata* Jones & Sherborn.

#### Subgenus *PROTOACANTHOCY THERE* Bate 1963

#### *Acanthocythere (Protoacanthocythere) faveolata* Bate

1963 *Acanthocythere (Protoacanthocythere) faveolata* Bate : 195, pl. 7, figs. 5–13, pl. 8, figs. 1–5.

REMARKS. A few specimens of this species occur in the marl facies of the Basement Beds, Eastfield Quarry, South Cave. So far this species has not been found elsewhere at this horizon in Yorkshire.

### Genus *AULACOCY THERE* Bate 1963

TYPE SPECIES. *Aulacocythere punctata* Bate.

#### *Aulacocythere punctata* Bate

1963 *Aulacocythere punctata* Bate : 199, pl. 9, figs. 4–9, 11–12, 14–15.

REMARKS. Two specimens only of this species have been found at this horizon in Yorkshire in the Basement Beds (marl facies), Eastfield Quarry, South Cave.

Genus *MICROPNEUMATOCY THERE* nov.

DERIVATION OF NAME. Greek μικρός, small, bearing a resemblance to the genus *Pneumatocythere* Bate 1963.

DIAGNOSIS. Carapace small, convex, with ventrolateral margin projecting strongly below ventral surface in side view. Left valve larger than right. Radial pore canals straight, widely spaced, and few in number. Hinge antimerodont. Muscle scars as for family (Type A).

TYPE SPECIES. *Micropneumatocythere convexa* sp. nov.

REMARKS. Through the kindness of Dr. G. A. Cooper (Smithsonian Institute) topotype material of *Procytheridea crassa* Peterson (1954, pl. 19, figs. 1-5) was examined. As previously stated (Bate 1963 : 214) this species is not congeneric with *P. exempla* Peterson (1954, pl. 19, figs. 6-14), the type species of *Procytheridea* Peterson 1954. Although the muscle scars were not discernible in the topotype material all other evidence points to the fact that *P. crassa* belongs in the genus *Micropneumatocythere*.

*Micropneumatocythere convexa* sp. nov.

(Pl. 2, figs. 12-13, Pl. 3, figs. 1-15)

?1960 Ostracod No. 3. Lutze : 434, pl. 38, fig. 1a-b.

DERIVATION OF NAME. Latin, *convexus*, arched.

DIAGNOSIS. A *Micropneumatocythere* with carapace strongly convex in dorsal view, with coarse reticulate ornament.

HOLOTYPE. Io. 921, Basement Beds (marl facies), Eastfield Quarry, South Cave.

PARATYPES. Io. 922-26, horizon and locality as above.

DESCRIPTION. Carapace oval in side view with the ventrolateral border extended below the ventral surface, the position of the overhang varying from almost median to posterior. Dorsal margin convex, ventral margin anteromedially incurved. Anterior broadly rounded ; posterior rounded triangular with a concave postero-dorsal slope and a convex posteroventral slope. Sexual dimorphism well developed, the presumed males being the more elongate. Greatest length passes through midpoint ; greatest height at or slightly in front of valve middle whilst the greatest width occurs at or just behind valve middle. Shell surface strongly reticulate. Ventral surface of each valve possesses 4 or 5 longitudinal ridges. Normal pore canals large, only clearly seen around the periphery of the carapace. Left valve larger than the right, which it overlaps along the ventral margin, slightly along the anterodorsal and posterodorsal slopes, and overreaches anteriorly and mid-dorsally. Right valve with a strongly concave posterodorsal slope, the posterior being almost upturned, overreaching the left valve at this point. Hinge antimerodont, left valve with a broad shelf-like accommodation groove ; right valve with 7 terminal teeth. Muscle scars (Type A, Bate 1963) situated anterior to valve

centre consisting of a vertical row of 4 oval adductor scars with a single, rounded anterodorsal antennal scar and a single, rounded anteroventral mandibular scar. The position of the antennal scar varies slightly in the individual, although basically anterodorsal it may approach an anteromedian position. *Inner margin* and *line of concrescence* coincide; *radial pore canals* short and straight, widely spaced, approximately 9 anteriorly and 3 posteriorly.

#### *Dimensions*

Holotype. Io. 921 female carapace (Pl. 3, figs. 1-4) length 0.51 mm.; height 0.34 mm.; width 0.32 mm.

Paratypes. Io. 922 male carapace (Pl. 3, figs. 5-7) length 0.60 mm.; height 0.36 mm.; width 0.33 mm. Io. 923 male R.V. (Pl. 3, figs. 11, 13-15) length 0.60 mm.; height 0.33 mm. Io. 924 male L.V. (Pl. 3, fig. 10) length 0.55 mm.; height 0.33 mm. Io. 925 female R.V. (Pl. 2, fig. 12, Pl. 3, fig. 8) length 0.43 mm.; height 0.25 mm. Io. 926 female L.V. (Pl. 2, fig. 13, Pl. 3, figs. 9, 12) length 0.48 mm.; height 0.32 mm.

REMARKS. This species occurs in the Hydraulic Limestone of Castle Howard and Ganthorpe and, more commonly, in the Basement Beds (marl facies), Eastfield Quarry, South Cave. In Lincolnshire it has been found in the Kirton Cementstone Series, Greetwell Quarry, Lincoln.

Although closely similar in outline to *Procytheridea crassa*, *M. convexa* differs noticeably in the following ways: greatest height median and not in the anterior third; more strongly convex in dorsal view, *P. crassa* tending to be almost parallel-sided; smaller in size, with a much more strongly swollen ventrolateral bulge. This species also closely resembles *Procytheridea reticulata* Klingler & Neuweiler (1959, pl. 14, figs. 19-21, 23-25), the latter is, however, almost parallel-sided in dorsal view with compressed anterior and posterior borders, characters not found in *M. convexa*. Ostracod No. 3, Lutze (1960, pl. 38, fig. 1a-b), most closely resembles this species and is tentatively placed in synonymy.

### Genus *PNEUMATOCY THERE* Bate 1963

TYPE SPECIES. *Pneumatocythere bajociana* Bate.

#### *Pneumatocythere bajociana* Bate

1963 *Pneumatocythere bajociana* Bate: 193, pl. 5, figs. 7-10, pl. 6, figs. 1-10, pl. 7, figs. 1-4.

REMARKS. *P. bajociana* occurs throughout South Yorkshire in the Hydraulic Limestone and associated marine sediments at all the localities examined.

### Subfamily PLEUROCYTHERINAE Mandelstam 1960

#### Genus *PLEUROCY THERE* Triebel 1951

TYPE SPECIES. *Pleurocythere richteri* Triebel.



*Pleurocythere kirtonensis* Bate

1963 *Pleurocythere kirtonensis* Bate : 203, pl. 10, figs. 14-18, pl. 11, figs. 1-5.

REMARKS. A single specimen of this species has been found in the Basement Beds (marl facies), South Cave. No other occurrence of this species in Yorkshire at this horizon has so far been noted.

*Pleurocythere* sp.

(Pl. 4, figs. 1-2)

REMARKS. A single right valve (Io. 928), length 0.55 mm.; height 0.27 mm., has been found in the Basement Beds (marl facies), Eastfield Quarry, South Cave, which agrees closely with the genus and is at the same time unlike any previously described species.

Family CYTHERIDEIDAE Sars 1925

Subfamily CYTHERIDEINAE Sars 1925

Genus *DOLOCY THERE* Mertens 1956

TYPE SPECIES. *Dolocythere rara* Mertens.

*Dolocythere maculosa* Bate

1963 *Dolocythere maculosa* Bate : 205, pl. 12, figs. 1-11.

REMARKS. An abundant species within the Basement Beds (marl facies), South Cave (the type locality). So far it has not been found elsewhere at this horizon in Yorkshire.

Genus *HOMOCY THERIDEA* nov.

DERIVATION OF NAME. Greek, ὁμοῦς, uniform, + *cythereida*.

DIAGNOSIS. Elongate, parallel-sided, broadly rounded anteriorly and posteriorly. Hinge antimerodont. Muscle scars with crescentic anterodorsal antennal scar. Inner margin and line of concrescence coincide; radial pore canals few in number, straight and widely spaced.

TYPE SPECIES. *Homocythereida cylindrica* sp. nov.

REMARKS. This genus, which is placed in the subfamily on account of shape, type of muscle scars (Type B, Bate 1963) and radial pore canals, differs from *Clithrocythereida* Stephenson (1936) in the more uniform outline and fewer radial pore canals.

*Homocythereida cylindrica* sp. nov.

(Pl. 4, figs. 3-11)

DERIVATION OF NAME. Latin, *cylindrus*, a cylinder.

DIAGNOSIS. A *Homocythereida* with carapace cylindrical in outline, punctate.

HOLOTYPE. Io. 938, Basement Beds (marl facies), Eastfield Quarry, South Cave.

PARATYPES. Io. 939-43, horizon and locality as above.

DESCRIPTION. *Carapace* elongate-oval with the greatest length passing through midpoint; greatest height in the anterior third; greatest width in the posterior

third. Dorsal and ventral margins almost parallel, sloping slightly to the posterior. Anterior broadly rounded; posterior narrower, also rounded. Ventral margin convex, incurved anteromedially. Dorsal margin convex in the right valve, almost straight in the left. Cardinal angles broadly rounded. *Shell surface* finely punctate. *Normal pore canals* large and widely spaced, rounded. Relationship of left to right valves is not known as a complete carapace has not been found. *Hinge* antimerodont, the median element in the left valve being a long, narrow, finely denticulate bar with no real accommodation groove above. 8 terminal teeth in the right valve. *Muscle scars* (Type B) consist of 4 oval adductor scars in a vertical row with a strongly crescentic anterodorsal antennal scar and an oval anteroventral mandibular scar. Dorsal muscle scars occur above the adductor scars (Pl. 4, fig. 7). *Inner margin* and *line of conrescence* coincide; *duplicature* of moderate width; *radial pore canals* straight, widely spaced, approximately 11 anteriorly and 4 posteriorly.

#### *Dimensions*

Holotype. Io. 938 L.V. (Pl. 4, figs. 3, 5, 9) length 0.81 mm.; height 0.43 mm.

Paratypes. Io. 939 R.V. (Pl. 4, figs. 4, 6, 10) length 0.85 mm.; height 0.42 mm. Io. 940 L.V. (Pl. 4, fig. 8) length 0.87 mm.; height 0.43 mm. Io. 941 L.V. (Pl. 4, figs. 7, 11) length 0.80 mm.; height 0.43 mm. Io. 942 R.V. length 0.79 mm.; height 0.38 mm. Io. 943 L.V. length 0.79 mm.; height 0.41 mm.

REMARKS. This species has so far been found only at the type locality. It does not occur in large numbers.

### Genus *TETRACYTHERIDEA* nov.

DERIVATION OF NAME. Greek, τέτταρες, four, with reference to the outline of the carapace, + *cytheridea*.

DIAGNOSIS. Carapace angular subquadrate to subrectangular; thick shelled; dorsal margin straight or slightly convex; anterior and posterior margins rounded. Hinge antimerodont. Muscle scars with crescentic anterodorsal antennal scar. Radial pore canals few in number, straight or very slightly curved, widely spaced. Inner margin and line of conrescence coincide. Left valve larger than right.

TYPE SPECIES. *Tetracytheridea punctata* sp. nov.

REMARKS. *Tetracytheridea* has been placed in the subfamily Cytherideinae on general shape, type and arrangement of muscle scars (Type B) and simple radial pore canals. Although similar in outline to the genera *Asciocythere* Swain, *Schuleridea* Swartz & Swain, *Praeschuleridea* Bate and *Galliaecytheridea* Oertli, it differs from these by the arrangement of the muscle scars, the antennal scar being quite definitely anterodorsal in position, as opposed to an anteromedian position for the others, and in several cases by the possession of an antimerodont hinge. The dorsal margin, especially in the left valve, is typically straight in this genus, not nearly as convex as in the others.

*Tetracytheridea punctata* sp. nov.

(Pl. 5, figs. 1-11, Pl. 6, figs. 1-2)

DERIVATION OF NAME. Latin, *punctum*, a small hole.

DIAGNOSIS. A *Tetracytheridea* with carapace punctate.

HOLOTYPE. Io. 944 Basement Beds (marl facies), Eastfield Quarry, South Cave.

PARATYPES. Io. 945-49, horizon and locality as above.

DESCRIPTION. *Carapace* subquadrate in outline, tapering posteriorly. Dimorphism indicated by the presence of a single elongate left valve which is considered to be the male. Greatest length passes through midpoint in both dimorphs; greatest height in the anterior third; greatest width behind midpoint. Ventro-lateral border slightly swollen, extended below the ventral surface. *Shell surface* finely punctate. *Normal pore canals* large, circular and widely spaced over the carapace. *Left valve* larger than the right, producing the typical subquadrate outline. The left valve overlaps the right in the region of the cardinal angles and along the ventral margin. Cardinal angles distinct. Dorsal margin straight, sloping steeply to the bluntly rounded posterior. Anterior uniformly rounded. Ventral margin with an anteromedian incurvature. *Right valve* oval in outline, tapering to the narrowly rounded posterior; anterior broadly rounded. Dorsal margin slightly convex; ventral margin incurved anteromedially. *Hinge* anti-merodont; coarsely loculate terminal sockets, dentate median bar with virtually no accommodation groove in the left valve. Right valve with 7-8 terminal teeth, the median loculate groove being slightly overhung by the dorsal edge of the valve. *Muscle scars* (Type B) consist of a vertical row of 4 oval adductor scars in front of which is a crescentic anterodorsal antennal scar and an oval or rounded antero-ventral mandibular scar. Several dorsal scars are situated above the adductor scars (Pl. 6, fig. 1). *Inner margin* and *line of conrescence* coincide; *duplicature* moderate in width; *radial pore canals* very slightly curved, widely spaced, approximately 11 anteriorly and 5 posteriorly. *Selvage* most clearly developed along the ventral and posterior margins.

*Dimensions*

Holotype. Io. 944 female carapace (Pl. 5, figs. 1, 2, 6) length 0.67 mm.; height 0.43 mm.; width 0.37 mm.

Paratypes. Io. 945 female L.V. (Pl. 5, figs. 7, 10, 11) length 0.73 mm.; height 0.48 mm. Io. 946 female R.V. (Pl. 5, figs. 4, 5, 8) length 0.71 mm.; height 0.43 mm. Io. 947 male L.V. (Pl. 6, figs. 1, 2) length 0.79 mm.; height 0.43 mm. Io. 948 female R.V. (Pl. 5, fig. 9) length 0.66 mm.; height 0.41 mm. Io. 949 female R.V. (Pl. 5, fig. 3) length 0.73 mm.; height 0.45 mm.

REMARKS. This species has so far been found only at the type locality and in the marine shale underlying the Hydraulic Limestone on the Firby road.

The single left valve considered here to be a male dimorph is very similar to *Homocytheridea cylindrica* in outline but can be distinguished by the upward sweep of the posteroventral border, typical of this species, but not found in *H. cylindrica*.

The radial pore canals cannot be clearly distinguished in the male dimorph ; the duplicature is, however, not quite as broad as in the compared species.

Family SCHULERIDEIDAE Mandelstam 1959  
Subfamily SCHULERIDEINAE Mandelstam 1959  
Genus *ASCIOCYTHERE* Swain 1952

TYPE SPECIES. *Bythocypris rotundus* Vanderpool.

*Asciocythere lacunosa* sp. nov.  
(Pl. 6, figs. 3-9, Pl. 7, figs. 1-6)

DERIVATION OF NAME. Latin, *lacunosus*, full of hollows.

DIAGNOSIS. An *Asciocythere* with carapace oval, greatest height median. Shell surface pitted. Hinge antimerodont.

HOLOTYPE. Io. 950, Basement Beds (marl facies), Eastfield Quarry, South Cave.

PARATYPES. Io. 951-53, horizon and locality as above.

DESCRIPTION. *Carapace* oval in side view, rather inflated. Greatest length passes through midpoint ; greatest height and width median. *Shell surface* with large scattered pits of varying size ; poorly preserved specimens may appear smooth. *Left valve* larger than the right which it overreaches along the dorsal margin and slightly around the posterior margin. Ventrally the left valve overlaps the right. Dorsal margin convex, cardinal angles rounded. Ventral margin incurved medially. Anterior and posterior margins rounded. *Right valve* rather more subquadrate in outline than the left, with distinct cardinal angles and steeply sloping anterodorsal and posterodorsal margins. Dorsal margin slightly convex, ventral margin medially incurved. Anterior and posterior margins rounded. In both valves there is a slight midventral bulge as seen in lateral view. *Hinge* antimerodont ; the terminal sockets in the left valve are rather coarsely loculate, the dentate median bar is short and the accommodation groove shelf-like and well developed. Generally there are 7 anterior and 7 posterior teeth in the right valve, although a single specimen with 6 anterior and 8 posterior teeth has been observed ; median groove short and coarsely loculate. *Muscle scars* (Type C) with 4 rounded adductor scars situated in a crescent, just anterior of valve centre ; an oval or slightly kidney-shaped anteromedian antennal scar, in front of which may be a very small circular scar and an anteroventral mandibular scar, not, however, clearly seen. *Inner margin* and *line of concrecence* coincide ; *duplicature* broad ; *radial pore canals* curved, arranged fan-like around the anterior margin, approximately 12 anteriorly, 4 posteriorly. *Selvage* well developed, particularly in the right valve.

*Dimensions*

Holotype. Io. 950 carapace (Pl. 6, figs. 3-6) length 0.71 mm. ; height 0.44 mm. ; width 0.36 mm.

Paratypes. Io. 951 L.V. (Pl. 6, figs. 7, 8, Pl. 7, fig. 5) length 0.80 mm.; height 0.49 mm. Io. 952 R.V. (Pl. 6, fig. 9, Pl. 7, figs. 1, 2, 4, 6) length 0.73 mm.; height 0.43 mm. Io. 953 R.V. (Pl. 7, fig. 3) length 0.73 mm.; height 0.41 mm.

REMARKS. This species has been found within the marine sediments which underlie the Hydraulic Limestone in the Firby road exposure as well as in the type locality. In Lincolnshire it is fairly common throughout the Lower Lincolnshire Limestone Greetwell Quarry, Lincoln, where it is, however, generally rather poorly preserved.

Genus *EOCYTHERIDEA* nov.

DERIVATION OF NAME. Greek,  $\xi\omega\varsigma$ , early, + *cytheridea*.

DIAGNOSIS. Elongate-oval to subtriangular. Left valve larger than right. Hinge hemimerodont, anterior socket of left valve extending backwards below median bar as a narrow groove; accommodation groove poorly developed. Muscle scars as for family. Inner margin and line of concrescence coincide; radial pore canals long, slightly curved, approximately 14 in number anteriorly.

TYPE SPECIES. *Eocytheridea elongata* sp. nov.

REMARKS. The genus has been placed in the Schulerideinae on shape, muscle scars (Type C) and radial pore canals. In outline it is close to *Clythrocytheridea* Stephenson (1936), from which it differs in the possession of a reduced number of radial pore canals and the anteromedian position of the antennal scar. The genus can also be distinguished from *Homocytheridea* on the basis of muscle scars, radial pore canals and in the more distinctly tapered posterior.

It has been observed in both species described below that, where the hinge of the left valve has been subjected to wear, the groove extending below the median bar from the anterior socket appears to extend along the top of the bar.

*Eocytheridea elongata* sp. nov.

(Pl. 7, figs. 7-12, Pl. 8, figs. 1-5)

DERIVATION OF NAME. *Elongatus*, prolonged.

DIAGNOSIS. An *Eocytheridea* with carapace elongate, posteriorly tapered. Shell surface strongly ornamented with both large and small pits, roughly circular in shape. 14 slightly curved anterior radial pore canals and 4 posterior canals.

HOLOTYPE. Io. 954, Basement Beds (marl facies), Eastfield Quarry, South Cave.

PARATYPES. Io. 955-59, horizon and locality as above.

DESCRIPTION. *Carapace* elongate, tapering to the posterior with the greatest length passing below midpoint; greatest height anterior of middle; greatest width below valve middle. *Shell surface* ornamented by roughly circular pits of two sizes: predominantly large pits inside of which a normal pore canal often opens and smaller, more numerous pits not apparently connected with pore canal openings. *Normal pore canals* most clearly seen around the periphery of the carapace; they do not appear to be very numerous over the central part of the valve.



*Left valve* larger than the right which it overlaps slightly along the ventral margin and overreaches along the dorsal margin. Dorsal margin convex, cardinal angles broadly rounded. Ventral margin incurved anteromedially. Anterior broadly rounded; posterior narrowly rounded. *Right valve* with a convex dorsal margin and rounded cardinal angles—the latter more noticeable than in the left valve. Ventral margin convex, incurved anteromedially. Anterior rounded; posterior tapering, narrowly rounded. In side view the ventral surface of each valve can be seen to possess a slight midventral swelling. *Hinge* hemimerodont, the anterior loculate socket of the left valve extending backwards, below the smooth median bar, only appearing to run along the bar in those specimens subjected to wear. Accommodation groove elongate and rather shallow. Right valve with approximately 7 anterior and 7 posterior teeth; the smooth median groove, slightly expanded anteriorly, is overhung by a long, narrow bar. *Muscle scars* (Type C) consist of a subvertical row of 4 oval adductor scars situated anterior of valve centre on the inside edge of a broad pit. An oval or slightly kidney-shaped antennal scar with a smaller scar in front is situated in an anteromedian position. The mandibular scar is anteroventrally situated. *Inner margin* and *line of conrescence* coincide; *duplicature* rather broad. *Radial pore canals* long, curved, 14 anteriorly and 4 posteriorly. *Selva* distinct. A small "lip" or triangular ledge is situated on the ventral surface of the right valve, below the anteromedian incurvature.

#### *Dimensions*

Holotype. Io. 954 R.V. (Pl. 7, figs. 8–10) length 0.91 mm.; height 0.47 mm.

Paratypes. Io. 955 L.V. (Pl. 7, figs. 7, 11, 12) length 0.81 mm.; height 0.44 mm. Io. 956 R.V. (Pl. 8, figs. 1, 2) length 0.97 mm.; height 0.49 mm. Io. 957 R.V. (Pl. 8, fig. 5) length 0.65 mm.; height 0.35 mm. Io. 958 carapace (Pl. 8, fig. 4) length 0.77 mm.; height 0.40 mm.; width 0.41 mm. Io. 959 L.V. (Pl. 8, fig. 3) length 0.67 mm.; height 0.35 mm.

REMARKS. The type locality is the only place where this species has been found.

#### *Eocytheridea lacunosa* sp. nov.

(Pl. 8, figs. 6–11, Pl. 9, figs. 1–8)

DERIVATION OF NAME. Latin, *lacunosus*, full of hollows.

DIAGNOSIS. An *Eocytheridea* with carapace subquadrate to subrectangular, dimorphic. Shell surface coarsely pitted.

HOLOTYPE. Io. 960, Basement Beds (marl facies), Eastfield Quarry, South Cave.

PARATYPES. Io. 961–64, horizon and locality as above and from the marine beds underlying the Hydraulic Limestone, Firby road exposure.

DESCRIPTION. *Carapace* subrectangular to subquadrate. Sexual dimorphism indicated by the presence of elongate (subrectangular) specimens which are here considered to be the males, the females being more subquadrate in outline. Greatest length passes through midpoint, greatest height in the anterior third, greatest width in the posterior third. *Left valve* larger than the right which it overlaps

along the ventral margin and in the region of the cardinal angles. Anteriorly and posteriorly the left valve slightly overreaches the right. Dorsal margin almost straight, cardinal angles distinct. Anterior and posterior margins rounded. Ventral margin medially incurved. *Right valve* with a slightly more marked posterior taper than the left and with a much more strongly convex dorsal margin, cardinal angles prominent. Anterior and posterior margins rounded, the latter more narrowly so. Ventral margin medially incurved with a triangular "lip" developed below. *Shell surface* ornamented with large, roughly circular pits with a subordinate number of smaller pits situated between, although in general all pits decrease in size towards the periphery. *Normal pore canals* most common around the outer margin of the carapace. *Hinge* hemimerodont, the anterior socket of the left valve continued below the smooth median bar as a narrow groove. Accommodation groove in this valve, elongate. Right valve with 6-7 terminal teeth. Median groove smooth, slightly expanded anteriorly and overhung by a long, narrow bar. *Muscle scars* (Type C) consist of a vertical row of 4 oval adductor scars with a single, anteromedian, slightly kidney-shaped antennal scar. So far a mandibular scar has not been observed. *Inner margin* and *line of concrescence* coincide; *duplicature* fairly broad; *radial pore canals* long, slightly curved and splayed out around the anterior margin; 14 anterior and 4 posterior canals observed.

#### *Dimensions*

Holotype. Io. 960 female carapace (Pl. 8, figs. 6, 8, 9) length 0.69 mm.; height 0.41 mm.; width 0.33 mm.

Paratypes. Io. 961 male carapace (Pl. 9, figs. 1-4) length 0.79 mm.; height 0.43 mm.; width 0.35 mm. Io. 962 female R.V. (Pl. 9, figs. 7, 8) length 0.67 mm.; height 0.35 mm. Io. 963 male L.V. (Pl. 9, figs. 5, 6) length 0.74 mm.; height 0.39 mm. Io. 964 male R.V. (Pl. 8, figs. 7, 10, 11) length 0.77 mm.; height 0.36 mm.

REMARKS. *Eocytheridea lacunosa* differs from the type species in being smaller, dimorphic and not so elongate in outline. It is also much more common in the sediments examined, being found not only at South Cave in the Basement Beds, but also in the marine sequence below the Hydraulic Limestone in the Firby road exposure, and approximately 10 ft. from the top of the Kirton Cementstone Series as exposed in the Greetwell Quarry, Lincoln.

### Genus *PARASCHULERIDEA* Swartz & Swain 1946

TYPE SPECIES. *Paraschuleridea anumbonata* Swartz & Swain.

REMARKS. The genus is placed in the family Schulerideidae, subfamily Schulerideinae, on shape and type of muscle scars present. The radial pore canals exhibited in the species described below are short, tending to enlarge at their base. It may well be that the genus will eventually be placed in a new subfamily on this latter evidence.

#### *Paraschuleridea ornata* sp. nov.

(Pl. 9, figs. 9-12, Pl. 10, figs. 1-3; Text-fig. 2)

DERIVATION OF NAME. Latin, *ornatus*, decorated.

DIAGNOSIS. A *Paraschuleridea* with carapace ornamented with large circular pits which decrease in size away from valve centre. In central part of valve pits are aligned in rows between transverse ridges, the latter diverging outwards from dorsal margin.

HOLOTYPE. Io. 965, Basement Beds (marl facies), Eastfield Quarry, South Cave.

PARATYPES. Io. 966-70, horizon and locality as above.

DESCRIPTION. *Carapace* subovate in outline, tapering to the posterior. Greatest length through midpoint; greatest height in the anterior third. *Shell surface* strongly ornamented with circular pits, increasing in size towards valve centre where they lie between prominent transverse ridges, the latter diverging outwards from the dorsal margin. In both valves there is a low, elongate swelling situated in the region of the anterior cardinal angle, below which there is a shallow, oblique furrow. *Normal pore canals* large, particularly well seen around the periphery of the valve. *Left valve* oval in outline; dorsal margin straight or slightly convex, sloping to the posterior. Anterior cardinal angle rounded, posterior angle rather more acute. Ventral margin medially incurved. Anterior margin compressed. *Right valve* slightly more angular in outline, particularly in the case of the cardinal angles. Dorsal margin convex; ventral margin medially incurved. Anterior broadly rounded, compressed; posterior triangular with a rather steep, slightly concave posterodorsal slope and a convex posteroventral slope. *Hinge* hemimerodont; left valve with rather elongate loculate sockets and a narrow, smooth bar above which there is an elongate accommodation groove. In the right valve there are approximately 5 anterior and 5 posterior teeth separated by a long, narrow, smooth groove. *Inner margin* and *line of concrescence* coincide; *duplicature* narrow; *radial pore canals* short, somewhat triangular in outline, widening towards

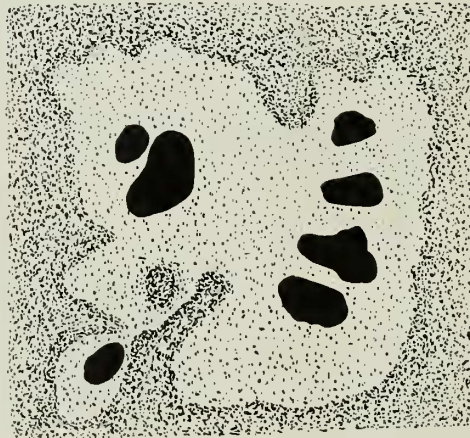


FIG. 2. Camera lucida drawing, muscle scars, *Paraschuleridea ornata* sp. nov., paratype Io. 969,  $\times 470$  approx.



the inner margin, anterior canals splayed out around the anterior margin. Approximately 11 anterior and 6 posterior canals. *Muscle scars* (Type C) consist of a subvertical row of 4 oval adductor scars, an anteromedian kidney-shaped antennal scar, the latter with a small circular scar in front, and a circular, anteroventral mandibular scar (Text-fig. 2). Above these there is a group of dorsal scars, the importance of which has not yet been ascertained.

#### *Dimensions*

Holotype. Io. 965 L.V. (Pl. 9, figs. 9, 11, 12) length 0.63 mm.; height 0.37 mm.

Paratypes. Io. 966 R.V. (Pl. 9, fig. 10, Pl. 10, figs. 1, 2) length 0.63 mm.; height 0.36 mm. Io. 967 L.V. length 0.65 mm.; height 0.39 mm. Io. 968 R.V. (Pl. 10, fig. 3) length 0.55 mm.; height 0.33 mm.

REMARKS. This species has so far been found only in the Basement Beds (marl facies), Eastfield Quarry, where it occurs (isolated valves only) in large numbers.

#### *Paraschuleridea* sp.

(Pl. 10, figs. 4-7)

REMARKS. Two single valves, similar in appearance to *P. ornata* have been found in the Basement Beds (marl facies), Eastfield Quarry, South Cave. Both valves are coarsely pitted but are slightly more elongate than, and without the transverse ridges of *P. ornata*.

#### *Dimensions*

Io. 971 R.V. (Pl. 10, figs. 6, 7) length 0.59 mm.; height 0.31 mm. Io. 972 L.V. (Pl. 10, figs. 4, 5) length 0.61 mm.; height 0.35 mm.

#### Genus *PRAESCHULERIDEA* Bate 1963

TYPE SPECIES. *Cytheridea subtrigona*, Jones & Sherborn.

#### *Praeschuleridea ventricosa ventricosa* (Plumhoff)

(Pl. 10, figs. 8-13, Pl. 11, figs. 1-9, Pl. 12, figs. 1-4, 7, 8)

1963 *Procytheridea* ? *ventricosa ventricosa* Plumhoff : 36, pl. 6, figs. 95-98.

DIAGNOSIS. A *Praeschuleridea* characterized by strong, transverse ridges, which in a few cases bifurcate at about valve centre, and large 5-6 sided pits arranged in rows parallel to ridges.

MATERIAL. Over 100 specimens from the Basement Beds (marl facies), Eastfield Quarry, South Cave. Registered Io. 973-82 and Io. 1219.

DESCRIPTION. *Carapace* oval in outline, strongly dimorphic, the presumed males being the more elongate. Greatest length passes through midpoint; greatest height slightly anterior of midpoint; greatest width median. *Shell surface* strongly ornamented with transverse ridges which radiate outwards from the dorsal margin and which may bifurcate at about valve centre. Large, 5-6 sided or rounded pits

are arranged in rows parallel to the ridges. The size of the pits decreases towards the periphery of the valve. *Normal pore canals* large, opening at the surface as circular pits, only clearly seen around the periphery of the carapace. *Left valve* larger than the right, which it overreaches on all sides except midventrally, where the left overlaps the right. Dorsal margin convex with rounded cardinal angles. Anterior and posterior rounded. Ventrolateral margin broadly convex; ventral margin anteromedially incurved. *Right valve* with more sharply angled cardinal angles. An oblique swelling is also situated on this valve, below the anterior cardinal angle. Associated with the swelling is an oblique furrow situated beneath. Anterior rounded; posterior rather triangular with a short and very steeply inclined posterodorsal slope and a convex posteroventral slope. Dorsal margin convex; ventrolateral margin broadly convex, overlapping the ventral surface, particularly midventrally. Ventral margin incurved anteromedially. Both valves possess an anterior marginal furrow which has the effect of producing a marginal rim. *Hinge* paleohemimerodont, with, in the left valve, terminal loculate sockets and a smooth median groove upraised across a smooth median bar. Accommodation groove broad and shelf-like. Right valve with 6-7 anterior and 7-8 posterior teeth, separated by a smooth median groove, across which the teeth are connected by a low ridge. *Inner margin* and *line of concrescence* coincide; *duplicature* broad; *radial pore canals* widely spaced and splayed out, fan-like, around the anterior margin, in which region there are 12 in number. Posteriorly there are approximately 4 pore canals. *Selvage* prominent; a narrow *flange* is present around the anterior margin of both valves. *Muscle scars* (Type C) consist of a crescent of 4 oval adductor scars with a kidney-shaped anteromedian antennal scar, in front of which there is a smaller, oval scar. Mandibular scar, usually oval, occupies an anteroventral position. Dorsal muscle scars are situated close to the hinge and occur directly above the adductor scars.

#### *Dimensions*

Io. 973 male carapace (Pl. 10, figs. 10, 12, 13) length 0.88 mm.; height 0.52 mm.; width 0.36 mm. Io. 974 female L.V. (Pl. 11, figs. 3, 6, Pl. 12, fig. 7) length 0.68 mm.; height 0.47 mm. Io. 975 female R.V. (Pl. 12, figs. 1, 2, 8) length 0.67 mm.; height 0.43 mm. Io. 976 female carapace (Pl. 11, figs. 2, 4, 5) length 0.68 mm.; height 0.45 mm.; width 0.37 mm. Io. 977 male L.V. (Pl. 10, fig. 8, Pl. 11, fig. 8) length 0.78 mm.; height 0.49 mm. Io. 978 male R.V. (Pl. 10, fig. 9, Pl. 11, figs. 7, 9) length 0.85 mm.; height 0.47 mm. Io. 979 female R.V. length 0.63 mm.; height 0.41 mm. Io. 980 male L.V. (Pl. 10, fig. 11, Pl. 11, fig. 1) length 0.88 mm.; height 0.49 mm. Io. 981 male R.V. (Pl. 12, fig. 4) length 0.56 mm.; height 0.31 mm.

REMARKS. *P. ventricosa ventricosa* occurs in large numbers within the marl facies of the Basement Beds, Eastfield Quarry, and is also common in the marine sediments underlying the Hydraulic Limestone in the Firby road section. A loose block of the Hydraulic Limestone collected at Ganthorpe also contained examples of this species. In Lincolnshire, several specimens have been found at about the centre of the Kirton Cementstone sequence, Greetwell Quarry, Lincoln.

In outline and ornamentation this species approaches *Paraschuleridea ornata*,

from which it can, however, be distinguished by the hinge, radial pore canals, much coarser ornamentation, presence of strong dimorphism and the absence of the prominent posterior taper, characteristic of the latter.

*Praeschuleridea subtrigona* (Jones & Sherborn)

1888 *Cytheridea subtrigona* Jones & Sherborn : 265, pl. 2, fig. 9a-c.

1963 *Praeschuleridea subtrigona* (Jones & Sherborn) Bate : 207, pl. 12, figs. 12-16, pl. 13, figs. 1-9.

REMARKS. This species occurs within the Hydraulic Limestone facies of Ellerker, Castle Howard station, Ganthorpe and Firby road. At the latter locality it is also common within the underlying marine shale and sandstone. So far this species has not been found in the marl facies of the Basement Beds.

Family CYTHERURIDAE Müller 1894

Genus *CYTHEROPTERINA* Mandelstam 1956

TYPE SPECIES. *Cytheropterina vegranda* [*sic*] Mandelstam.

REMARKS. Although placed in synonymy with the genus *Orthonotacythere* Alexander 1933 (*in* Moore 1961 : Q 296), the genus is considered to be valid and distinguishable from the former by shape (here the presence of strong ventrolateral alar extensions of the carapace are important) and absence of a tubercular ornament. The genus is placed tentatively in the family Cytheruridae on shape of carapace.

*Cytheropterina comica* sp. nov.

(Pl. 12, figs. 5-18)

DERIVATION OF NAME. Latin, *comicus*, -a, -um, in allusion to the clown's mouth ornamentation on the ala.

DIAGNOSIS. A *Cytheropterina* with deeply sculptured alaeform extension of ventrolateral margin, each ala possessing a large crescent-shaped furrow, producing the "clown's mouth" allusion.

HOLOTYPE. Io. 990, Basement Beds (marl facies), Eastfield Quarry, South Cave.

PARATYPES. Io. 991-97, horizon and locality as above, including material from the Kirton Cementstone Series, Greetwell Quarry, Lincoln.

DESCRIPTION. *Carapace* ovoid in outline with a well developed alaeform projection of the ventrolateral margin and a short, upturned, caudal process. Greatest length, height and width median. Sexual dimorphism indicated by the presence of more elongate specimens considered to be males. *Shell surface* ornamented with an irregular series of furrows and ridges. A deep, almost S-shaped transverse furrow is situated at valve centre. The alae are deeply incised by two crescentic furrows, the uppermost of which is rather wide and gives the allusion referred to in the specific name. The lowermost of the two furrows parallels the ventral margin

of the ala. The ventral surface of each valve is ornamented with 3-4 longitudinal ridges, this ornament is absent in some specimens. *Normal pore canals* large, few in number and widely spaced, only clearly seen around the ventral margin of the alae. *Left valve* larger than the right which it overreaches along the dorsal margin and around the anterior. Ventrally the left valve slightly overlaps the right. Outline ovoid with convex dorsal and ventral margins, the latter possessing a shallow anteromedian incurvature. Cardinal angles rounded. Anterior uniformly rounded, posterior triangular, slightly upturned; posterodorsal slope strongly concave, posteroventral slope convex. *Right valve* similar in outline, the cardinal angles tend, however, to be more prominent. *Hinge* antimerodont with terminal loculate sockets, a finely denticulate median bar and a broad, shelf-like accommodation groove in the left valve. Right valve with approximately 6 terminal teeth and a median groove, not well preserved in the material examined, but presumably locellate. *Inner margin* and *line of concrescence* coincide; *radial pore canals* straight and widely spaced, 7 in number anteriorly and 5 posteriorly. *Muscle scars* (Type A) consist of a vertical row of 4 oval adductor scars situated anteriorly of midpoint, with a single, oval, anterodorsal antennal scar and a rounded anteroventral mandibular scar. *Selvae* distinct.

#### *Dimensions*

Holotype Io. 990 female L.V. (Pl. 12, figs. 9, 10) length 0.45 mm.; height 0.31 mm.

Paratypes. Io. 991 female carapace (Pl. 12, figs. 11-14) length 0.42 mm.; height 0.27 mm.; width 0.31 mm. Io. 992 female carapace length 0.41 mm.; height 0.28 mm.; width 0.25 mm. Io. 993 male L.V. (Pl. 12, figs. 5, 6, 15) length 0.52 mm.; height 0.32 mm. Io. 994 male L.V. (Pl. 12, figs. 16, 18) length 0.53 mm.; height 0.35 mm. Io. 995 female R.V. length 0.40 mm.; height 0.28 mm. Io. 996 male R.V. (Pl. 12, fig. 17) length 0.52 mm.; height 0.31 mm.

REMARKS. This species occurs not only in the marl facies of the Basement Beds (where it is the most abundant) but also in the Hydraulic Limestone of Ganthorpe and Firby road and in the Kirton Cementstone Series of Lincoln. It is not, however, common or particularly well preserved in the latter sediments.

#### *Cytheropterina gravis* sp. nov.

(Pl. 13, figs. 1-10)

DERIVATION OF NAME. Latin, *gravis*, serious, pertaining to the thin, incised furrow on the ala.

DIAGNOSIS. *Cytheropterina* with weakly ornamented carapace; transverse wrinkles at valve centre, narrow crescentic furrow on each ala.

HOLOTYPE. Io. 998, Basement Beds (marl facies), Eastfield Quarry, South Cave.

PARATYPES. Io. 999-Io. 1004, horizon and locality as above, including material from the Kirton Cementstone Series, Greetwell Quarry, Lincoln.

DESCRIPTION. *Carapace* oval in outline with a short, upturned caudal process and a ventrolateral alar extension. Greatest length, height and width median. Sexual dimorphism indicated by the presence of elongate specimens, considered



to be the males. *Shell surface* weakly ornamented with transverse wrinkles, and a deeply incised central furrow. A narrow, crescentic furrow extends across the base of each ala, approximately paralleling the outline of the structure. *Left valve* larger than the right which it overlaps along the ventral margin, but overreaches dorsally. Dorsal margin broadly convex, cardinal angles indistinct. Ventral margin convex with a shallow, anteromedian incurvature. Ventrolateral margin extended to form an alae-form process which projects below the ventral surface. Anterior broadly rounded, posterior bluntly triangular, upturned. Posterodorsal slope strongly concave, posteroventral slope convex. *Right valve* similar in outline, but with more prominent cardinal angles. *Hinge* antimerodont, with terminal loculate sockets, a finely denticulate median bar and a narrow accommodation groove in the left valve. Right valve with 6 anterior and 9 posterior teeth and a narrow median groove. *Muscle scars* (Type A) consist of a vertical row of 4 oval adductor scars, a single, rounded, anterodorsal antennal scar and a single, rounded anteroventral mandibular scar. *Inner margin* and *line of concrecence* coincide; *radial pore canals* not clearly seen but anteriorly appear to consist of 4-5 straight, widely spaced canals.

#### *Dimensions*

Holotype. Io. 998 male L.V. (Pl. 13, figs. 1, 2, 7) length 0.57 mm.; height 0.37 mm.

Paratypes. Io. 999 female R.V. (Pl. 13, figs. 3, 6, 8) length 0.41 mm.; height 0.28 mm. Io. 1000 female L.V. (Pl. 13, figs. 4, 5) length 0.43 mm.; height 0.29 mm. Io. 1001 female L.V. (Pl. 13, fig. 10) length 0.41 mm.; height 0.29 mm. Io. 1002 male L.V. (Pl. 13, figs. 9, 11) length 0.51 mm.; height 0.31 mm. Io. 1003 male L.V. length 0.54 mm.; height 0.33 mm. Io. 1004 male carapace length 0.53 mm.; height 0.32 mm.; width 0.36 mm.

REMARKS. *Cytheropterina gravis* differs from *C. comica* in the narrowness of the crescentic furrow situated at the base of the ala. It is this distinction which has given rise to the two specific names. The basic valvular ornamentation is weaker in the former species, which also tends to have a less prominent ala.

Apart from the type locality, where it is fairly common, *C. gravis* occurs in the marine strata underlying the Hydraulic Limestone, Firby road section, and throughout the Kirton Cementstone Series, Greetwell Quarry, Lincoln.

Family PROTOCYTHERIDAE Ljubimova 1955

Subfamily KIRTONELLINAE Bate 1963

Genus **KIRTONELLA** Bate 1963

TYPE SPECIES. *Kirtonella plicata* Bate.

#### *Kirtonella plicata* Bate

1963 *Kirtonella plicata* Bate : 210, pl. 13, figs. 10-19, pl. 14, figs. 1-6, 11-12.

REMARKS. A single male carapace has been found within the Hydraulic Limestone facies, Firby road.

Genus *EKTYPHOCY THERE* Bate 1963TYPE SPECIES. *Procytheridea triangula* Brand.*Ektyphocythere triangula* (Brand)1961 *Procytheridea triangula* Brand : 161, pl. 1, figs. 11-14.1963 *Ektyphocythere triangula* (Brand) Bate : 214, pl. 15, figs. 5-18.

REMARKS. The lowest horizon at which this species has been found in Yorkshire is the Hydraulic Limestone, in which it occurs at Ellerker, Firby road and Ganthorpe. At South Cave the species occurs in the overlying marl facies of the Basement Beds.

Genus *KINKELINELLA* Martin 1960TYPE SPECIES. *Kinkelinella tenuicostati* Martin.*Kinkelinella ? bajociana* sp. nov.

(Pl. 13, figs. 12-19)

DIAGNOSIS. Like *Kinkelinella* with shell surface finely pitted, almost smooth. Radial pore canals straight, approximately 8 anteriorly ; inner margin and line of concrescence coinciding. Muscle scars with V-shaped anterodorsal antennal scar. Left valve larger than right.

HOLOTYPE. Io. 1008, Basement Beds (marl facies), Eastfield Quarry, South Cave.

PARATYPE. Io. 1009, horizon and locality as above.

DESCRIPTION. *Carapace* subquadrate in outline, tapering slightly to the posterior. Dorsal margin very slightly convex, almost straight ; cardinal angles rounded. Ventrolateral margin convex. Ventral margin incurved posteromedially. Anterior broadly rounded ; posterior narrowly rounded. Greatest length through midpoint ; greatest height in the anterior third ; greatest width median. *Shell surface* ornamented with shallow, irregular-sided pits producing an almost reticulate appearance, but only weakly so. *Normal pore canals* large and widely scattered. Left valve larger than the right, which it overlaps along the ventral margin, particularly midventrally, and in the region of the antero- and posterodorsal slopes. Anteriorly the left valve overreaches the right. Only in the *right valve* have the internal details been observed. *Hinge* hemimerodont with 5 anterior and 6 posterior teeth. Median groove smooth and elongate. *Inner margin* and *line of concrescence* coincide ; *duplicature* quite broad ; *radial pore canals* not clearly seen but appear to be slender, straight and widely spaced, approximately 8 anteriorly, not seen posteriorly. *Muscle scars* consist of a vertical row of 4 oval adductor scars with a V-shaped anterodorsal antennal scar and a rounded, anteroventral mandibular scar (Type D).

*Dimensions*

Holotype. Io. 1008 carapace (Pl. 13, figs. 12-16) length 0.53 mm.; height 0.32 mm.; width 0.27 mm.

Paratype. Io. 1009 R.V. (Pl. 13, figs. 17-19) length 0.48 mm.; height 0.29 mm.

REMARKS. The genus *Kinkelinella* was erected by Martin (1960) for a single species, *K. tenuicostati*, which occurs in the Liassic *Dactylioceras tenuicostatum* Zone of Germany. In shape, hinge and radial pore canals *K. ? bajociana* agrees closely with the characters of the genus. However, the assignment of the present species to the genus is only tentative at the moment because of the lack of knowledge concerning the muscle scars of the type species. Certainly the muscle scars as exhibited by *K. ? bajociana*, together with the hemimerodont hinge, are sufficient to distinguish this genus from other genera present within the Lower and Middle Jurassic sediments, which possess a superficial external resemblance.

### Genus *SYSTEMENOCYHERE* Bate 1963

TYPE SPECIES. *Systemenocythere exilofasciata* Bate.

#### *Systemenocythere exilofasciata* Bate

1963 *Systemenocythere exilofasciata* Bate : 212, pl. 14, figs. 7-10, 13-17, pl. 15, figs. 1-4.

REMARKS. A single male carapace (Io. 615, figured, Bate 1963, pl. 14, figs. 14, 15) has been found in the Basement Beds (marl facies), Eastfield Quarry, South Cave. It has not been recorded from any other locality.

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#### IV. APPENDIX

While the present paper was in press, two publications (listed below) appeared in which Middle Jurassic Ostracoda were described from Germany. Of these the more immediately important is that of Plumhoff, who describes and figures the ostracod *Procytheridea ? ventriosa*, attributing the species to "Fischer (in press)". It is of course Plumhoff's species.

The type subspecies is here referred to the genus *Praeschuleridea*, although space did not permit the listing of a complete synonymy. The synonymies of other species affected are being brought up to date in a paper on the Middle Jurassic Ostracoda of Yorkshire.

- PLUMHOFF, F. 1963. Die Ostracoden Oberalenium und tiefen Unterbajocium (Jura) des Gifhorner Troges, Nordwestdeutschland. *Abh. Senckenb. naturf. Ges.*, Frankfurt a.M., **503** : 1-100, pls. 1-12.
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